

Background

1. The Codex Committee on Food Hygiene held in December 2008 agreed with the proposal to develop an annex on control measures for *Vibrio parahaemolyticus* and *Vibrio vulnificus* in molluscan shellfish to the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio species in Seafood* as discussed under Agenda Item 8. The Committee agreed to reconvene the physical working group led by Japan, open to all interested parties and working in English only to develop this Annex for circulation at Step 3 for comments and consideration by the next session of the Committee (ALINORM 09/32/13 para.146).
2. The physical working group to be led by Japan will meet on 26 – 29 May in Kyoto and consider a proposed draft annex on Control Measures for *V. parahaemolyticus* and *V. vulnificus* in Molluscan Shellfish, as presented in Appendix to this document.
3. Members and observers of the Codex Alimentarius Commission are invited to provide comments in writing, preferably by e-mail to Japanese Secretariat of the physical working group (<mailto:codexj@mhlw.go.jp>), before 10 May 2009.

PROPOSED DRAFT ANNEX ON THE CONTROL MEASURES FOR *VIBRIO PARAHAEMOLYTICUS* AND *VIBRIO VULNIFICUS* IN BIVALVE MOLLUSCS¹

INTRODUCTION

1. Bivalve molluscs are an important food source in international trade and are a well documented vehicle for transmission of illnesses caused by *Vibrio* spp. worldwide, especially *Vibrio parahaemolyticus* and *Vibrio vulnificus*. Bivalve molluscs are unique in that they are harvested, handled and consumed differently than most other seafood products and therefore present unique risks and control options. They are inherently more risky than other seafoods because of their filter feeding activity that concentrates pathogens present in the water and also they may be consumed whole and raw or after insufficient cooking. Unlike most other aquatic species that are slaughtered at harvest, bivalve molluscs may be able to survive out of the water for days after harvest at temperatures that permit the growth of *V. parahaemolyticus* and *V. vulnificus* with little loss of quality. In many countries, bivalve molluscs are often held at ambient temperatures for extended periods resulting in post-harvest growth of these pathogens and that contributes heavily to their risk, according to recently completed FAO/WHO risk assessments for both of these pathogens².

SECTION I – OBJECTIVES

2. The purpose of this Annex is to minimize the likelihood of illness arising from the presence of pathogenic *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs. Thus the focus of this document will be the control of *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs, especially minimizing and/or preventing the contamination and/or the growth of these pathogens, and proper cooking of bivalve molluscs to be consumed after cooking. Controls for these pathogens are similar but differ to the extent that characteristics of growth and survival differ. The controls outlined in this Annex will reflect these differences, where they exist. This Annex also provides information that will be of interest to regulatory authorities, the food industry, consumers, and other interested parties.

SECTION II – SCOPE, DEFINITION AND USE OF THE DOCUMENT

2.1 SCOPE

3. This Annex covers bivalve molluscs that are marketed in a live, raw or partially treated state. The target microbiological hazards of this Annex are *V. parahaemolyticus* and *V. vulnificus*.
4. This Annex highlights the key control measures that influence the frequency and extent of contamination with *V. parahaemolyticus* and *V. vulnificus* and thus the risk of foodborne diseases caused by these pathogens.
5. This Annex is applicable throughout the food chain, from primary production through consumption. Additionally, guidance is provided on post-harvest processing. Controls in Part I below apply to a live and raw bivalve molluscs (including the those received post-harvest processing), while those in Part II apply to bivalve molluscs consumed after cooking, but by tradition the cooking may be insufficient and is responsible for infections by these vibrio pathogens³.

¹ Phylum Mollusca: Class Bivalvia

² FAO/WHO has developed and published Risk assessments of *Vibrio vulnificus* in raw oysters (2005), *V. parahaemolyticus* in bloody clams and *V. parahaemolyticus* in raw oysters (in Press). This Annex is based on key findings and outcomes derived from these risk assessments and other relevant epidemiological evaluations.

³ Risk assessment of *V. parahaemolyticus* in bloody clams

2.2 DEFINITIONS

6. For the purpose of this annex, the following definitions apply:

Definitions contained in the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3); and

Post-harvest processing: processes intended to significantly reduce or limit but not completely eliminate *V. parahaemolyticus* and *V. vulnificus* to level of the satisfaction of the official agency having jurisdiction while essentially retaining the sensory characteristics of live bivalve molluscs (e.g. freezing, high pressure and mild heating).

2.3 USE OF THE DOCUMENT

7. This Annex is supplemental to and should be used in conjunction with the *Recommended International Code of Practice - General Principles of Food Hygiene* (CAC/RCP 1-1969), the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52-2003), Hygiene section of the *Standard for Live and Raw Bivalve Molluscs* (Step 8) and the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3). The use of this Annex may require modifications and amendments that take into account such factors as regional differences in the prevalence and virulence of *V. parahaemolyticus* and *V. vulnificus* and susceptibility of the population.
8. In many instances, the control measures are articulated in a general manner in the *Recommended International Code of Practice - General Principles of Food Hygiene* (CAC/RCP 1-1969) as part of the general strategy for the control of foodborne pathogens in all foods. In providing this Annex, it is assumed that the *General Principles of Food Hygiene* are being implemented.

PART I: Bivalve molluscs consumed in live and raw status

SECTION III - PRIMARY PRODUCTION

3.1 ENVIRONMENTAL HYGIENE

9. Refer to Section 3.1 of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products*, (CAC/RCP 52 – 2003) and Section 3.1 of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
10. The controls described in this section generally apply to pre-harvest environmental conditions and practices during and immediately following harvest, typically while under the control of the harvester. Effective control of *V. parahaemolyticus* and *V. vulnificus* will typically require an evaluation of the risk associated with the harvesting area based on epidemiology and environmental conditions (i.e. water temperature and salinity, air temperature). An important element in estimating risk is understanding that *V. parahaemolyticus* grows faster and at colder temperatures than *V. vulnificus* (growth rates for *V. parahaemolyticus* and *V. vulnificus* are provided in Table 1). Predictive tools⁴ using these environmental monitoring parameters and growth rates as inputs have been developed based on the FAO/WHO risk assessments and are available to estimate corresponding *V. parahaemolyticus* and *V. vulnificus* levels and risk.

⁴ Construction of predictive tools using *V. parahaemolyticus* / *V. vulnificus* Risk Calculation worksheets, undertaken by the United States is being in progress. The United States will present an example of a risk calculator at the Working Group meeting in Kyoto.

11. In cases where predictive models are used to estimate the concentration of pathogenic *Vibrio* spp. in seawater and/or bivalve molluscs based on water temperatures and/or salinity, their accuracy would be enhanced by incorporating local data and considering additional factors such as hydrodynamic effects (currents, tides, hurricanes, rainfall, etc.) and sunlight.
12. Monitoring of bivalve molluscs at harvest for the levels of total *V. vulnificus* and total and pathogenic *V. parahaemolyticus* should be conducted to determine the regional and seasonal variation. This information is useful for model inputs and evaluation of model outputs and application of appropriate controls.
13. When testing or monitoring indicates the likelihood of an unacceptable risk, control measures contained in Sections 3.2 (HYGIENIC PRODUCTION OF FOOD SOURCES), 3.3 (HANDLING STORAGE AND TRANSPORT) and 5.1 (CONTROL OF FOOD HAZARDS) and 5.2 (KEY ASPECTS OF HYGIENE CONTRIL SYSTEMS) of this Annex should be implemented. Bivalve molluscs intended for further treatment (i.e. post-harvest processing) may not require these control measures.
14. Additionally, there are some indications that *Vibrio* spp. can be introduced into a harvest area through the release of ballast water. Therefore, the impact of ballast discharge should be considered in the classification of harvest waters for the control of *V. parahaemolyticus* and *V. vulnificus*, especially in areas that are in close proximity to international shipping lanes.
15. Factors to be considered in determining the need for controls in a given harvest area include:
 - The intended use of the product (e.g., post-harvest processing);
 - The number of sporadic *V. parahaemolyticus* and *V. vulnificus* illnesses associated with bivalve molluscs harvested from a distinct hydrographic area, and whether these illnesses are indicative of an annual reoccurrence;
 - Any reported outbreak that is linked to a distinct hydrographic area;
 - Water temperatures representative of harvesting conditions. Water temperatures below 15°C⁵ for *V. parahaemolyticus* and 20°C for *V. vulnificus* have generally not been historically associated with illnesses;
 - Post-harvest air temperatures above the minimum growth temperatures for *V. parahaemolyticus* (10°C) and *V. vulnificus* (13°C), which may increase risk regardless of harvest water temperature;
 - Methods of harvest that allow radiant solar heating to raise shellfish temperatures to temperatures above ambient air temperatures prior to harvest (i.e., intertidal harvest);
 - Salinity ranges and optima are different for *V. parahaemolyticus* and *V. vulnificus*. Environmental and epidemiological data indicate low *V. parahaemolyticus* and *V. vulnificus* levels and few cases of illnesses are associated with bivalve molluscs when salinity exceeds 35 ppt (g/l) and 30 ppt (g/l), respectively.
16. The activities described in this section should be applied under the supervision of the regulatory authority having jurisdiction.

3.2 HYGIENIC PRODUCTION OF FOOD SOURCES

17. The following pre-harvest and harvest controls should be applied as necessary based upon the factors identified in Section 3.1 above.
 - Restrict harvest or otherwise prevent use of product for raw consumption (e.g. close area to harvest or divert product for further processing).

⁵ J. B. McLaughlin, A. DePaola, C. A. Bopp, K. A. Martinek, N. P. Napolilli, C. G. Allison, S. L. Murray, E. C. Thompson, M. M. Bird, and J. P. Middaugh. Outbreak of *Vibrio parahaemolyticus* gastroenteritis associated with Alaskan oysters. *N Engl J Med JID* - 0255562 353 (14):1463-1470, 2005.

3.3 HANDLING, STORAGE AND TRANSPORT

18. The following controls during handling, storage and transport of harvested bivalve molluscs should be applied as necessary based upon the factors identified in Section 3.1 above.
- Limit time from harvest or first exposure to ambient air temperature, to initial refrigeration based on modeling and sampling to achieve the appropriate level of protection.
 - Minimize time and temperature conditions that would allow the growth of *V. parahaemolyticus* and *V. vulnificus* during wet storage of bivalve molluscs.
 - Minimize time to reach temperature at which growth of pathogenic *Vibrio* spp. do not occur during refrigeration by improving cooling efficiency (e.g. cold water, ice, blast chilling, configuring shellfish for greater air flow).
 - It may be useful to monitor levels of *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs at various points in the distribution chain to verify effectiveness of recommended controls.
 - Anyone involved in the handling, storage or transport of bivalve molluscs should be educated regarding the relationship between temperature control and growth.

SECTION IV - ESTABLISHMENT: DESIGN AND FACILITIES

19. Refer to Section IV of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section IV of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION V - CONTROL OF OPERATION

5.1 CONTROL OF FOOD HAZARDS

20. Refer to Section 5.1 of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003), the *Guidelines for the Validation of Food Safety Control Measures* (CAC/GL 69 – 2008) and Section 5.1 of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
21. The controls described in this section generally apply to post-harvest handling and processing. Control of *V. parahaemolyticus* and *V. vulnificus* will typically require the stringent application of Good Hygienic Practices and other supportive programs. These prerequisite programs, together with HACCP, can provide a sound framework for the control of *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs.
22. Any measure or practice selected to reduce/inactivate *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs or control/minimize the growth of these organisms (e.g. freezing, high pressure, mild heating, etc.), should be adequately validated to ensure that the control measure is effective. Such a validated control measures/practices should be implemented under the HACCP system. *V. parahaemolyticus* is generally more resistant than *V. vulnificus* to any given vibriocidal treatment. Therefore, a process that is effective for *V. vulnificus* may not be as effective for *V. parahaemolyticus*.

5.2 KEY ASPECTS OF HYGIENE CONTROL SYSTEMS

5.2.1 Time and temperature control

23. Refer to Section 4.1 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52-2003). Time and temperature are the most important factors affecting the rate of growth and survival of *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs.

5.2.2 Specific process steps

24. For *V. parahaemolyticus* and *V. vulnificus* various reduction/inactivation technologies (e.g. freezing, high pressure and mild heating), have been developed and others are being developed.
25. Control measures should be in place to prevent bivalve molluscs produced for consumption after cooking is not distributed as those for raw consumption.

SECTION VI - ESTABLISHMENT: MAINTENANCE AND SANITATION

26. Refer to Section VI of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section VI of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION VII - ESTABLISHMENT: PERSONAL HYGIENE

27. Refer to Section VII of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section VII of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION VIII – TRANSPORTATION

28. Refer to Section VIII of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION IX - PRODUCT INFORMATION AND CONSUMER AWARENESS

29. Refer to Section IX of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
30. In addition, programs for consumer information should be directed at consumers with increased susceptibility to contracting vibriosis, such patients with as liver diseases and immunocompromised persons to help consumers make informed choices about purchase, storage, shelf-life labelling and appropriate consumption of a live and raw bivalve molluscs, taking into consideration the specific regional conditions and consumption habits.
31. Further, public warning notices should be provided by both health care providers and at the point of sales. Point of sale warnings should be alert consumers to the increased risk of infection associated with the consumption of live and raw bivalve molluscs, especially those who are immunocompromised, and/ or having underlying diseases.

9.3 Labelling

32. Refer to Section 9.3 (Labelling) of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
33. Where appropriate, labeling for bivalve molluscs should include advice on safe handling practices and consumption. Further it should also indicate that bivalve molluscs is intended for raw consumption.

9.4 Consumer education

34. Refer to Section 9.4 (Consumer education) of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
35. Since each country has specific consumption habits, communication programs pertaining to *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs is most effective when established by individual governments.
36. Programs for consumer information should lead awareness of consumers to follow the instructions on handling and preparation of bivalve molluscs aimed at avoiding food safety risk associated with *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs.

SECTION X - TRAINING

37. Refer to Section X of the *Recommended International Code of Practice-General Principles of Food Hygiene*, (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products*, (CAC/RCP 52 – 2003) and Section X of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

PART II. Bivalve Molluscs consumed after Cooking⁶

SECTION III - PRIMARY PRODUCTION

3.1 ENVIRONMENTAL HYGIENE

38. Refer to Section 3.1 of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section 3.1 of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
39. Where necessary and appropriate, the controls described in Section III (PRIMARY PRODUCTION) of PART I may be implemented. Control measures should be in place to prevent bivalve molluscs produced for consumption after cooking is not distributed as those for raw consumption.

3.2 HYGIENIC PRODUCTION OF FOOD SOURCES

40. Refer to Section 3.2 of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section 3.2 of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
41. Where necessary and appropriate, the controls described in Section III (PRIMARY PRODUCTION) of PART I may be implemented. Control measures should be in place to prevent bivalve molluscs produced for consumption after cooking is not distributed as those for raw consumption.

3.3 HANDLING, STORAGE AND TRANSPORT

42. Refer to Section 3.3 of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section 3.3 of the Proposed Draft *Code of Hygienic Practice for Pathogenic*

⁶ PART II applies only to products which are partially treated. For products in thoroughly treated state, refer to relevant parts of the Good Hygienic Practices as specified in the *Recommended International Code of Practice - General Principles of Food Hygiene* (CAC/RCP 1-1969), *Code of Practice for fish and fishery products* (CAC/RCP 52-2003) and other applicable Codex documents as those are generally suitable to control *V. parahaemolyticus* and *V. vulnificus* in fully cooked bivalve molluscs.

Vibrio spp. in Seafood (at Step 3).

43. Where necessary and appropriate, the controls described in Section III (PRIMARY PRODUCTION) of PART I may be implemented. Control measures should be in place to prevent bivalve molluscs produced for consumption after cooking is not distributed as those for raw consumption.

SECTION IV - ESTABLISHMENT: DESIGN AND FACILITIES

44. Refer to Section IV of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION V - CONTROL OF OPERATION

5.1 CONTROL OF FOOD HAZARDS

45. Refer to Section 5.1 of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003), the *Guidelines for the Validation of Food Safety Control Measures* (CAC/GL 69 – 2008) and Section 5.1 of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
46. The controls described in this section generally apply to post-harvest handling and processing. Control of *V. parahaemolyticus* and *V. vulnificus* will typically require the stringent application of Good Hygienic Practices and other supportive programs. These prerequisite programs, together with HACCP, can provide a sound framework for the control of *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs.
47. *V. parahaemolyticus* is generally more resistant than *V. vulnificus* to any given vibriocidal treatment. Therefore, a process that is effective for *V. vulnificus* may not be as effective for *V. parahaemolyticus*.

5.2 KEY ASPECTS OF HYGIENE CONTROL SYSTEMS

5.2.1 Time and temperature control

48. Refer to Section 4.1 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52-2003). Oysters should be cooked so that internal temperature reaches to the extent where *V. parahaemolyticus* and *V. vulnificus* are destroyed. Achievement of the validated time and temperature treatment should be ensured.
49. Some heat treatment may not eliminate entire *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs. In these cases, growth of *V. parahaemolyticus* and *V. vulnificus* after heat treatment should be controlled.

5.2.2 Specific process steps

50. For pathogenic *V. parahaemolyticus* and *V. vulnificus* various reduction/inactivation technologies (e.g. freezing, high pressure and mild heating), have been developed and others are being developed.

5.2.4 Microbiological cross contamination

51. Refer to Section 5.2.3 of the *Recommended International Code of Practice- General Principles of Food Hygiene* (CAC/RCP 1-1969) and the *Principles for the Establishment and Application of Microbiological Criteria for Foods* (CAC/GL 21-1997).
52. Control measures should be in place to avoid cross contamination between bivalve molluscs before heat treatment and after heat treatment, and between RTE food and bivalve molluscs before heat treatment.

SECTION VI - ESTABLISHMENT: MAINTENANCE AND SANITATION

53. Refer to Section VI of the *Recommended International Code of Practice-General Principles of Food*

Hygiene (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section VI of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION VII - ESTABLISHMENT: PERSONAL HYGIENE

54. Refer to Section VII of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section VII of Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION VIII – TRANSPORTATION

55. Refer to Section VIII of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section VIII of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

SECTION IX - PRODUCT INFORMATION AND CONSUMER AWARENESS

56. Refer to Section 9.1 of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52 – 2003) and Section 9.1 of the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).
57. Public warning notices should be provided by both health care providers and at the point of sales. Point of sale warnings should be alert consumers to the increased risk of infection associated with the consumption of undercooked bivalve molluscs.

9.3 Labeling

58. Refer to the *General Standard for the Labeling of Prepackaged Foods* (CODEX STANDARD 1-1985). Where appropriate, product labels should include information on safe handling practices and storage recommendations.
59. In addition, where appropriate, labeling for bivalve molluscs should include advice on safe handling practices and consumption. Further it should also indicate that bivalve molluscs is exclusively for further treatment (e.g. Cooking is required before consumption).

9.4 CONSUMER EDUCATION

60. Since each country has specific consumption habits, communication programs pertaining to *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs is most effective when established by individual governments.
61. Programs for consumer information should lead awareness of consumer to follow the instructions on handling and preparation of bivalve mollusks aimed at avoiding food safety risk associated with *V. parahaemolyticus* and *V. vulnificus* in bivalve molluscs.

SECTION X - TRAINING

62. Refer to Section X of the *Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1 - 1969), Section 7 of the *Code of Practice for Fish and Fishery Products*

(CAC/RCP 52 – 2003) and the Proposed Draft *Code of Hygienic Practice for Pathogenic Vibrio spp. in Seafood* (at Step 3).

Table 1. Temperature-specific *V. parahaemolyticus* and *V. vulnificus* growth rates and doubling times for calculating cumulative growth based on hourly temperature observations.

| Oyster Temperature (°C) | <i>V. parahaemolyticus</i> | | <i>V. vulnificus</i> | |
|-------------------------|------------------------------------|---------------------|------------------------------------|---------------------|
| | Growth rate ¹ (logs/hr) | Doubling time (hrs) | Growth rate ² (logs/hr) | Doubling time (hrs) |
| 10 | 0.008 | 35.8 | 0 | |
| 11 | 0.013 | 24.0 | 0 | |
| 12 | 0.017 | 17.3 | 0 | |
| 13 | 0.023 | 13.0 | 0 | |
| 14 | 0.030 | 10.1 | 0.011 | 27.4 |
| 15 | 0.037 | 8.11 | 0.022 | 13.7 |
| 16 | 0.045 | 6.64 | 0.033 | 9.12 |
| 17 | 0.054 | 5.54 | 0.044 | 6.84 |
| 18 | 0.064 | 4.69 | 0.055 | 5.47 |
| 19 | 0.075 | 4.02 | 0.066 | 4.56 |
| 20 | 0.086 | 3.49 | 0.077 | 3.91 |
| 21 | 0.099 | 3.06 | 0.088 | 3.42 |
| 22 | 0.112 | 2.70 | 0.099 | 3.04 |
| 23 | 0.126 | 2.40 | 0.110 | 2.74 |
| 24 | 0.140 | 2.15 | 0.121 | 2.49 |
| 25 | 0.156 | 1.93 | 0.132 | 2.28 |
| 26 | 0.172 | 1.75 | 0.143 | 2.11 |
| 27 | 0.189 | 1.59 | 0.154 | 1.95 |
| 28 | 0.207 | 1.45 | 0.165 | 1.82 |
| 29 | 0.226 | 1.33 | 0.176 | 1.71 |
| 30 | 0.246 | 1.23 | 0.187 | 1.61 |
| 31 | 0.266 | 1.13 | 0.198 | 1.52 |
| 32 | 0.287 | 1.05 | 0.209 | 1.44 |
| 33 | 0.309 | 0.97 | 0.220 | 1.37 |
| 34 | 0.332 | 0.91 | 0.231 | 1.30 |
| 35 | 0.356 | 0.85 | 0.242 | 1.24 |

¹ Square root of growth rate (in logs/hr) = 0.0202*Temperature – 0.1103, if Temperature > 10°C

² Growth rate (in logs/hr) = 0.011*(Temperature -13) if Temperature > 13°C